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THE ENGINEER MODELING STUDY.(U)
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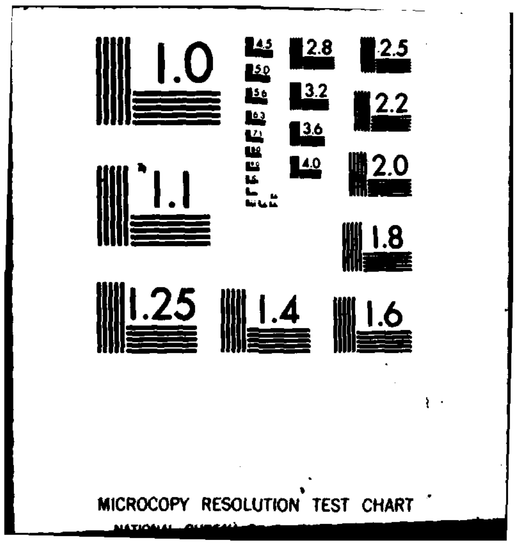
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MICROCOPY RESOLUTION TEST CHART

BAGBY, D. GORDON

THE ENGINEER MODELING STUDY

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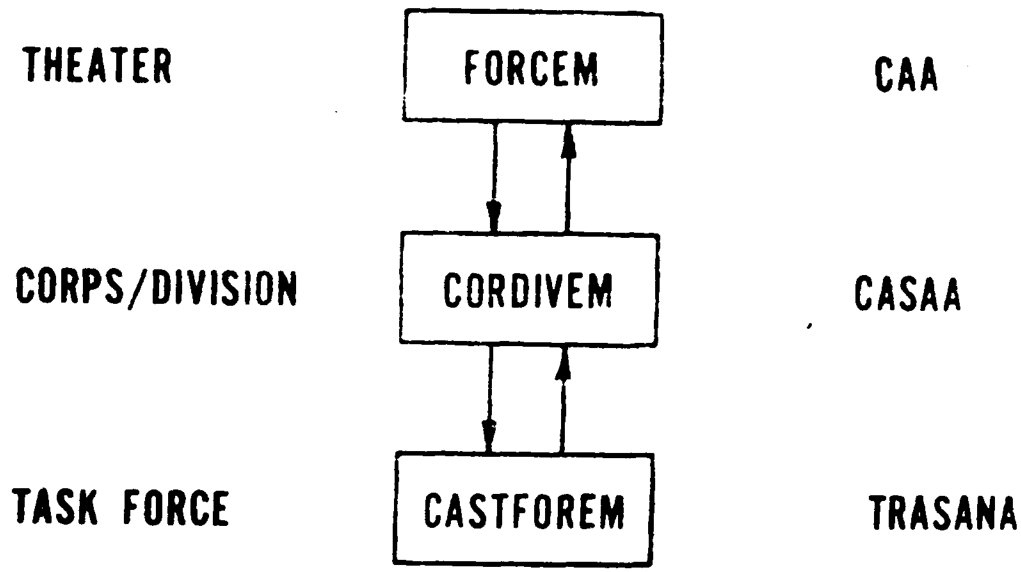
The objective of the Engineer Modeling Study is to measure the contribution of combat engineers to the effectiveness of the combined arms team. The research program originated from a Mission Area Analysis (the Engineer Family of Systems Study (E-FOSS)), which noted that Army war games were good at representing unit offensive and defensive movements, but weak in modeling the impact of US and Soviet Union combat engineer activities on battle outcomes. In 1979, the US Army Engineer School (USAES), representing the Training and Doctrine Command (TRADOC), requested the US Army Construction Engineering Research Laboratory (CERL) to correct this deficiency. The Engineer Modeling Study was the result.

The Engineer Modeling Study itself is part of the larger Army Model Improvement Program (AMIP) which seeks to improve the caliber and quality of Army war games. The three AMIP models shown in Figure 1 interact by feeding scenarios downward from higher theater-level games to lower level division and battalion-level games and by transmitting combat results upward from battalion-level games to theater-level models. The AMIP model used in the Engineer Modeling Study is the mid-level Corps/Division Evaluation Model (CORDIVEM) being developed by the Combined Arms Studies and Analysis Activity (CASAA). An implicit goal of the Engineer Modeling Study is accurate and consistent representation of the effectiveness of engineer effort throughout the AMIP model hierarchy.

Figure 2 illustrates how the Engineer Modeling Study augments the Corps/Division Evaluation Model with an Engineer Module. This module receives orders either from the CORDIVEM gamer or indirectly from within the game; the module then modifies various CORDIVEM terrain features. These terrain modifications produce three effects: mobility effects enhancing the movement of friendly troops; survivability effects reducing friendly force casualties; and countermobility effects delaying the movement of hostile forces.

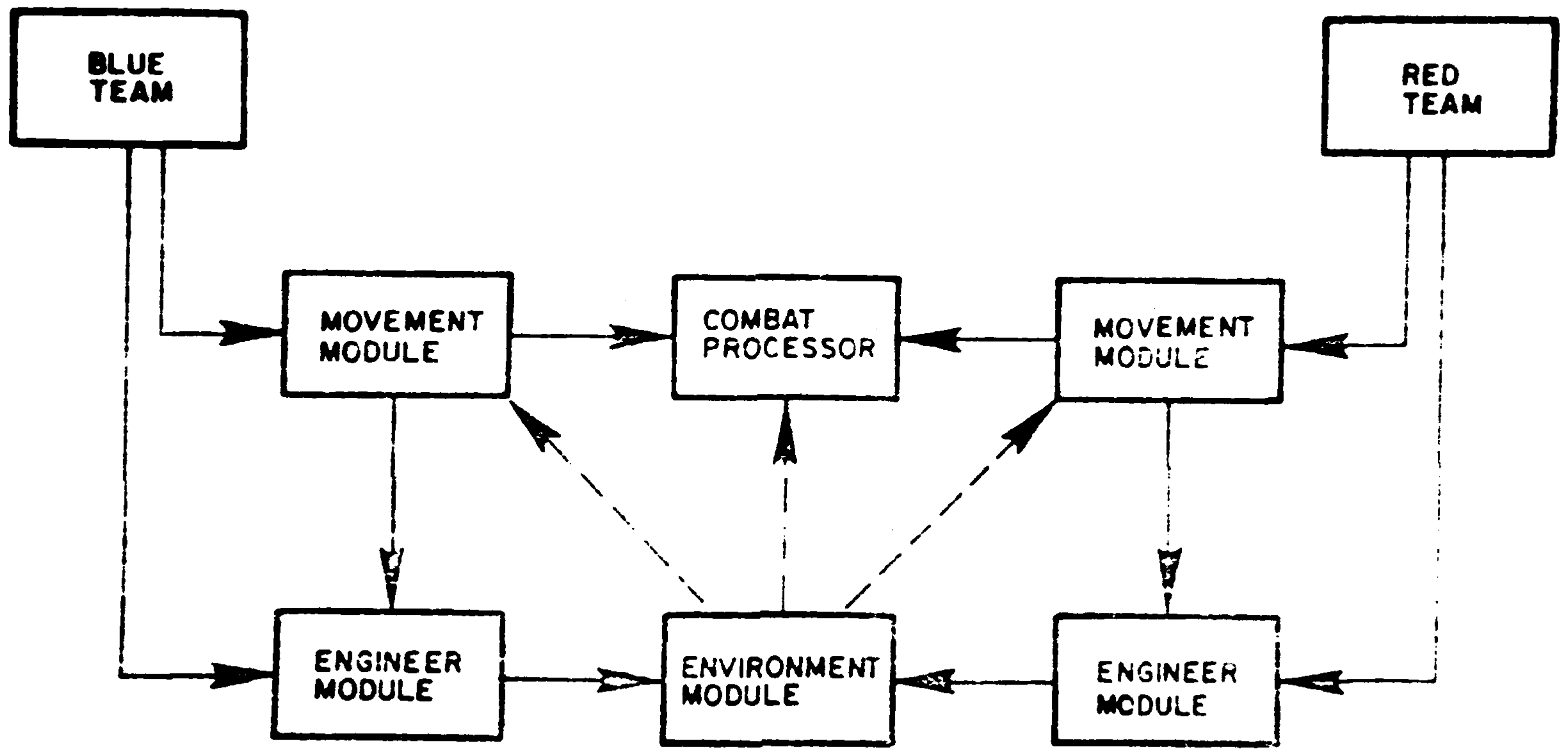
The Engineer Module is comprised of the three submodules (Figure 3):

ENGINEER MODELING STUDY (EMS)
BACKGROUND



ARMY MODEL IMPROVEMENT PROGRAM (AMIP) HIERARCHY

Figure 1



CORPS BATTLE GAME STRUCTURE

Figure 2

ENGINEER PROCESS MODULE

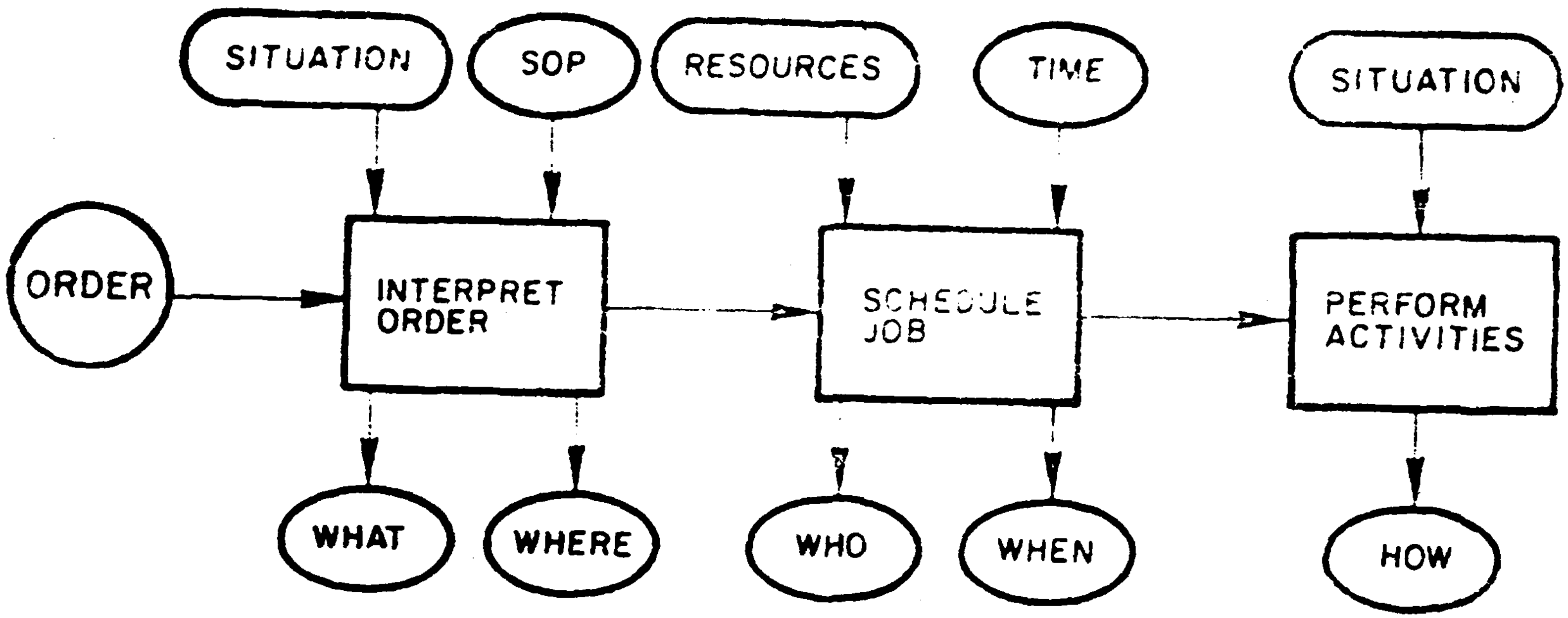


Figure 3

an interpret order submodule; a schedule job submodule; and a perform activity submodule. Once the Engineer Module receives orders from CORDIVEM, it interprets these orders, schedules jobs to satisfy these orders, performs the jobs, and appropriately modifies the CORDIVEM terrain.

The heart of the perform activity submodule is a set of critical path networks. For example, Figure 4 represents the precedence network for a minefield breach. Each step of this technique is shown as an activity. Given the location of the job site and the locations of the required resources, the perform activity submodule determines the completion time of the job and the resources expended.

The Engineer Module is now fully operational. It is compatible with any order stream, and can represent over 50 separate engineer activities such as blowing a bridge, building a command post, or conducting reconnaissance missions.

The schematic diagram shown in Figures 5, 6, and 7 illustrate the actual operation and interaction of CORDIVEM and the Engineer Module. Everything within the dashed lines belongs to CORDIVEM; everything outside the dashed lines is the responsibility of the Engineer Module. The time clock, or event queue, for CORDIVEM appears in the center; CORDIVEM's data files and mapboard appear on the right. The operation of the Engineer Module commences on the left with the receipt of an order from CORDIVEM, generated by either the gamer, a pregame plan, or the CORDIVEM game itself. Regardless of the source, once an order is received, it is processed by the interpret order and schedule job submodules. The interpret order submodule selects an appropriate critical path network. The schedule job submodule then places the start times for the individual events of the critical path network into the event queue of CORDIVEM's time line. The Engineer Module then goes to sleep (Figure 5). With the passage of time, CORDIVEM's TIME NOW marker moves downward. When TIME NOW reaches the start time of an activity, CORDIVEM passes control of the process back to the Engineer Module's perform activity submodule. This submodule computes a FINISH TIME and places a marker on the time line in the appropriate place (Figure 6). Finally, when TIME NOW reaches FINISH TIME, the Engineer Module's modify terrain submodule is activated and CORDIVEM's data base is changed to reflect the terrain alteration. The data base, in turn, changes the information depicted on the CORDIVEM map (Figure 7).

If, at some subsequent point in time, enemy and friendly forces engage in combat in that location, their attrition rates and movement will be modified to reflect the presence of the engineer-created terrain feature.

M173 MINEFIELD BREACH TASK NETWORK

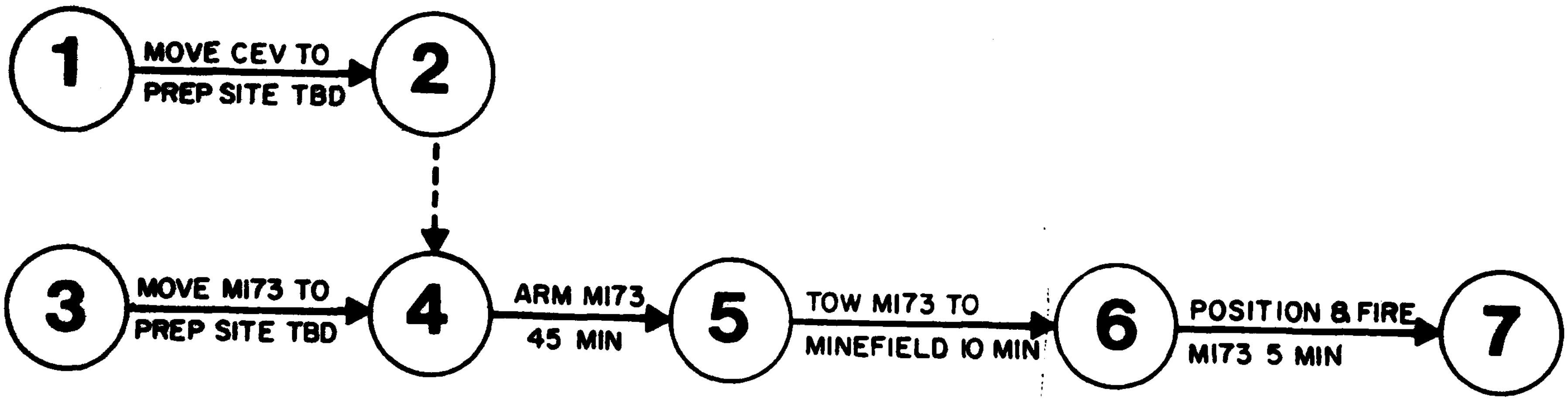


Figure 4

EVENT BASED SIMULATION (STEP 1)

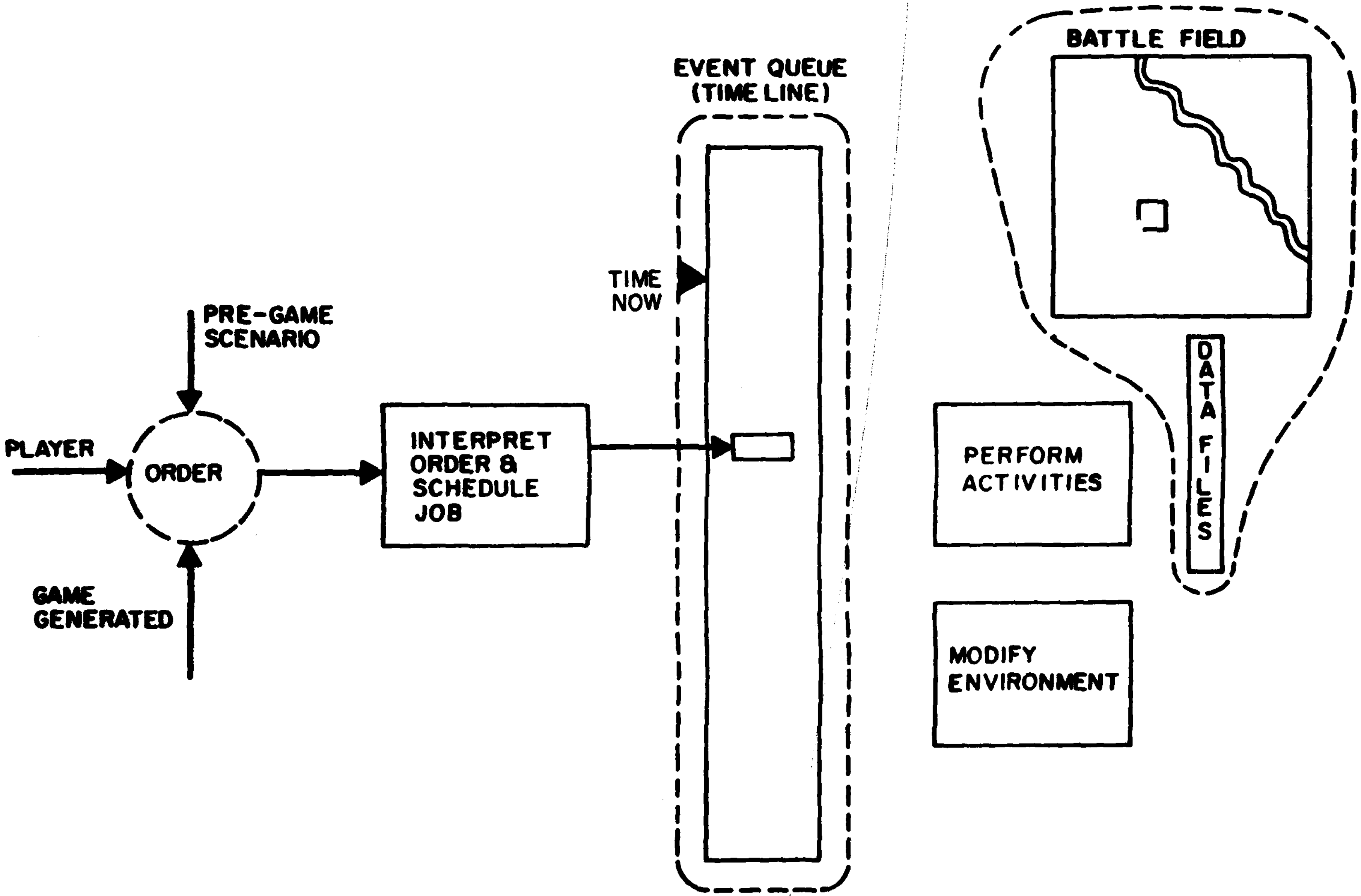


Figure 5

EVENT BASED SIMULATION (STEP 2)

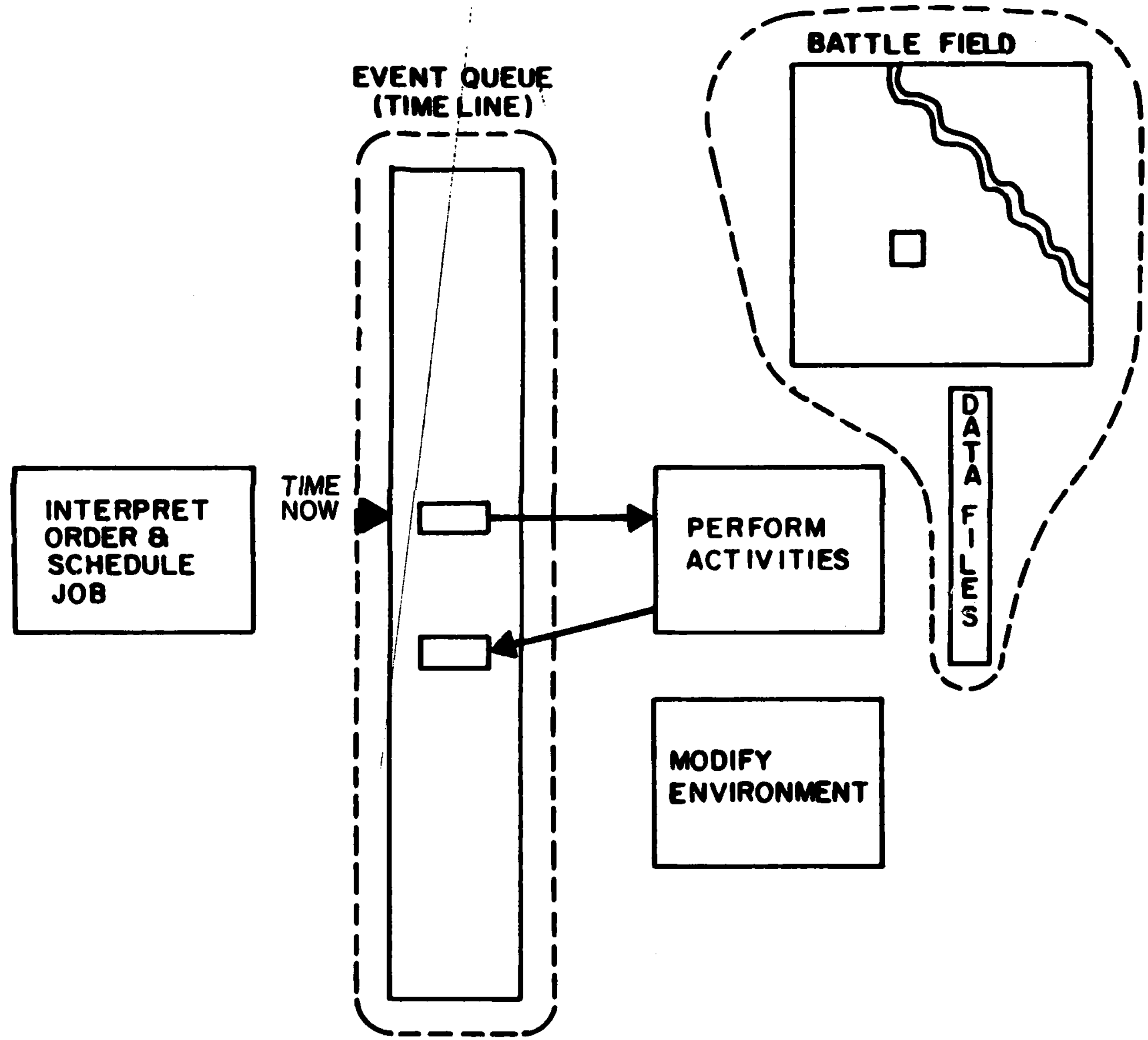


Figure 6

EVENT BASED SIMULATION (STEP 3)

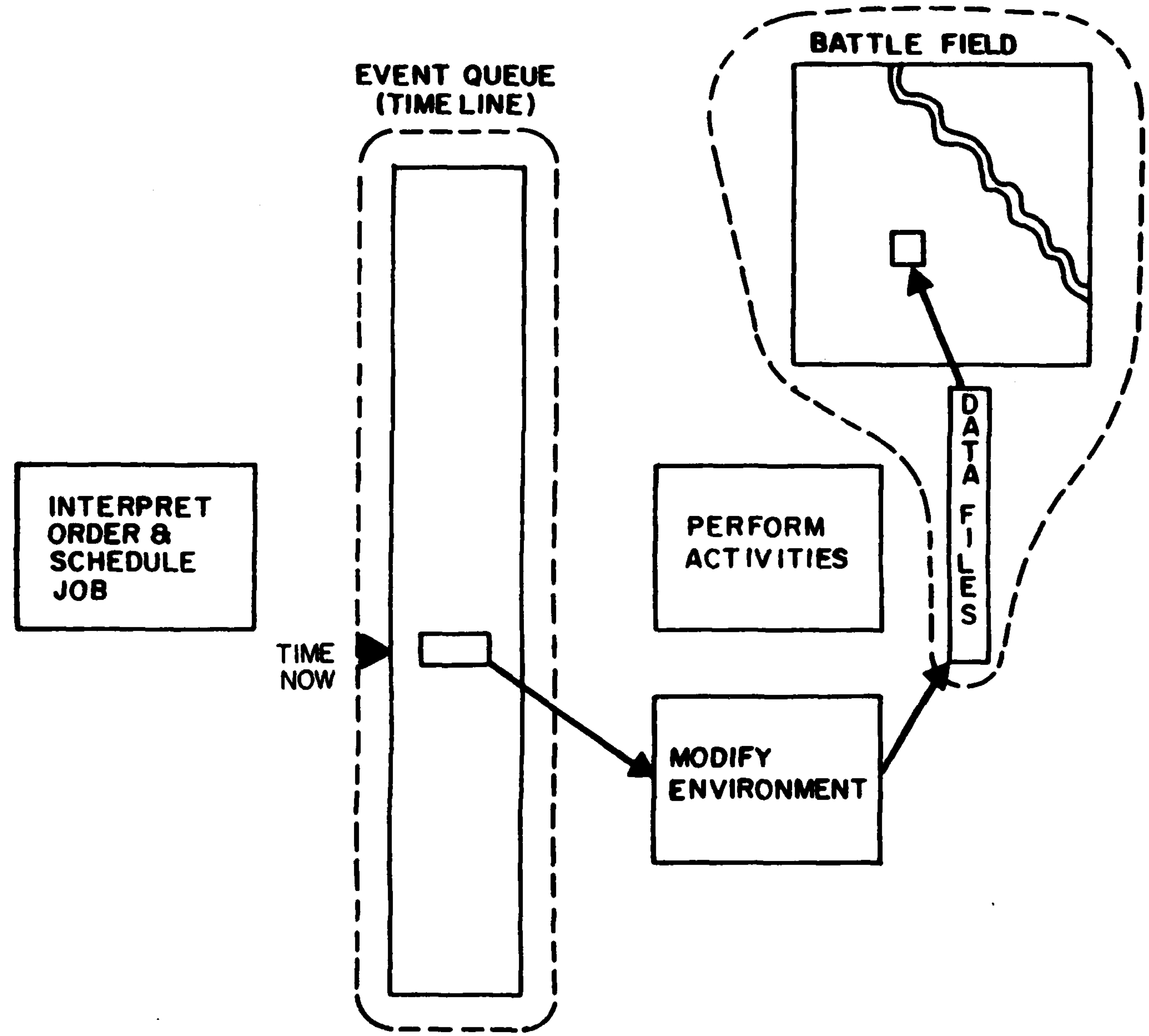


Figure 7

Figures 8, 9, and 10 are computer-drawn illustrations which depict how the CORDIVEM model ran in June 1981, both with and without combat engineer support. Figure 8 represents the initial situation at 7 AM, where five outnumbered blue armored cavalry squadrons (shown in white) confront seven red tank and reconnaissance battalions (black). By afternoon, without engineer support, blue forces were outflanked, forced to withdraw, encircled, and finally defeated by red units (Figure 9). But utilizing combat engineer support on the battlefield, bridges were destroyed and obstacles placed in the path of enemy forces to impede them until adequate defensive fortifications could be constructed (Figure 10). These efforts enabled blue forces to withstand the enemy attack for a considerably extended period, reduced blue losses, and increased red losses.

The results of these conflicts are tabulated in Figure 11. As this table indicates, when engineers were not available, red lost 73 tanks while blue suffered 62 tank casualties. With engineers present, red casualties rose to 88 tanks, while blue casualties fell to 49 tanks. It should be emphasized that these results were derived from a single scenario and many additional scenarios must be executed before the Engineer Module is credible.

During the remainder of Fiscal Year 82, sensitivity tests on the Engineer Module will be conducted and work will commence on a way to model threat engineers. Engineer Module documentation will be published containing flow charts, variable listings, definitions, information sources, and an operating manual.

In the more distant future, the Engineer Module will be used to conduct various force structure trade-off analyses and to create the following stand-alone Engineer Modules: A Force Structure Trade-Off Module for use in force design analysis; a Combat Engineer Field Module for use by combat engineer units for operational planning; and a Combat Engineer Training Module for use in training engineer officers and others.

To summarize, The Engineer Module is merely a resource allocation routine which receives orders, decrements resources, decrements time, modifies terrain, and issues statistics (Figure 12). The Engineer Module can be used to simulate the effects of different command and control structures, engineer support relationships, and engineer equipment performance characteristics. This ability to demonstrate engineer effectiveness on the battlefield should greatly assist efforts to modernize and field new engineer equipment.

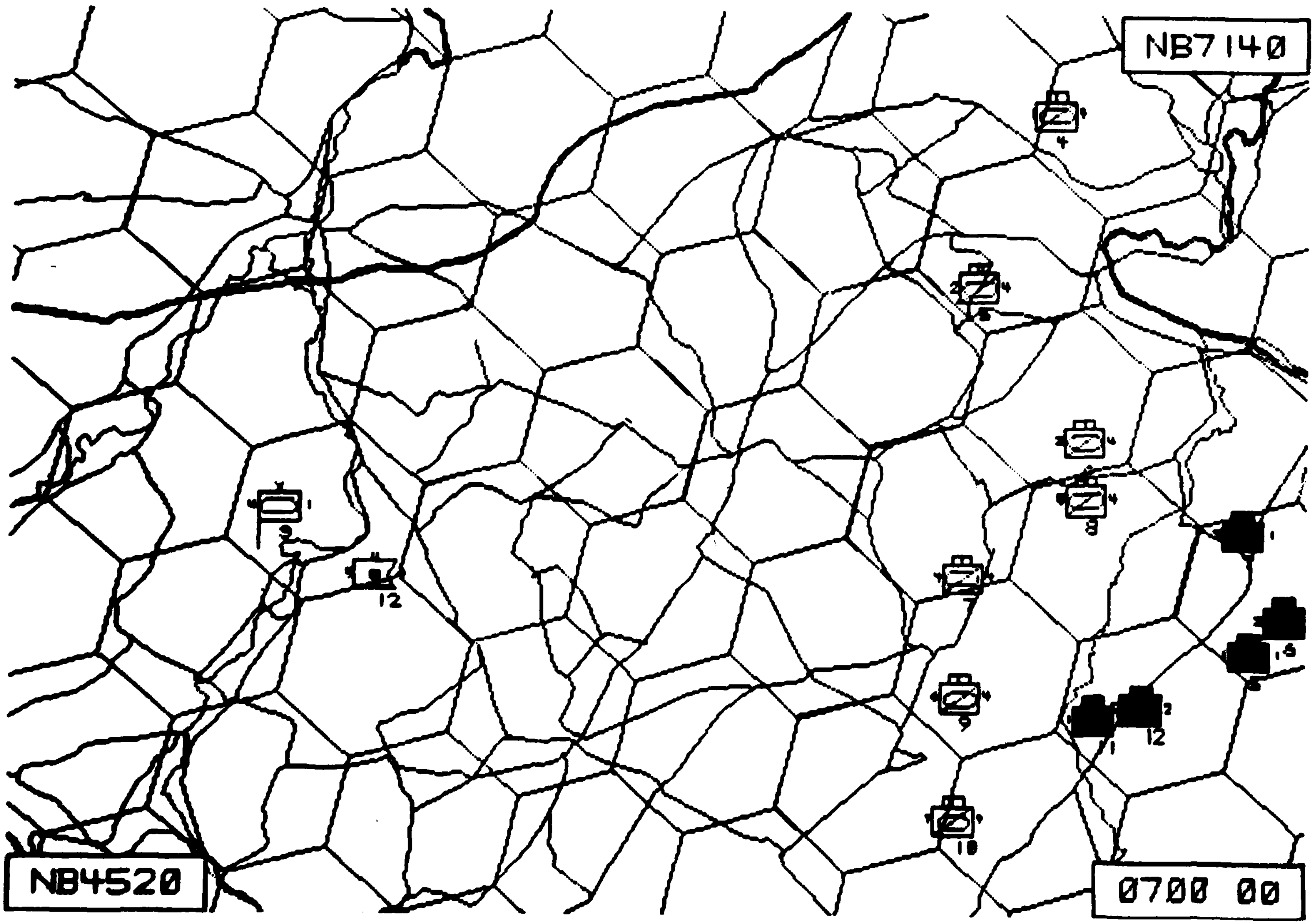


Figure 8

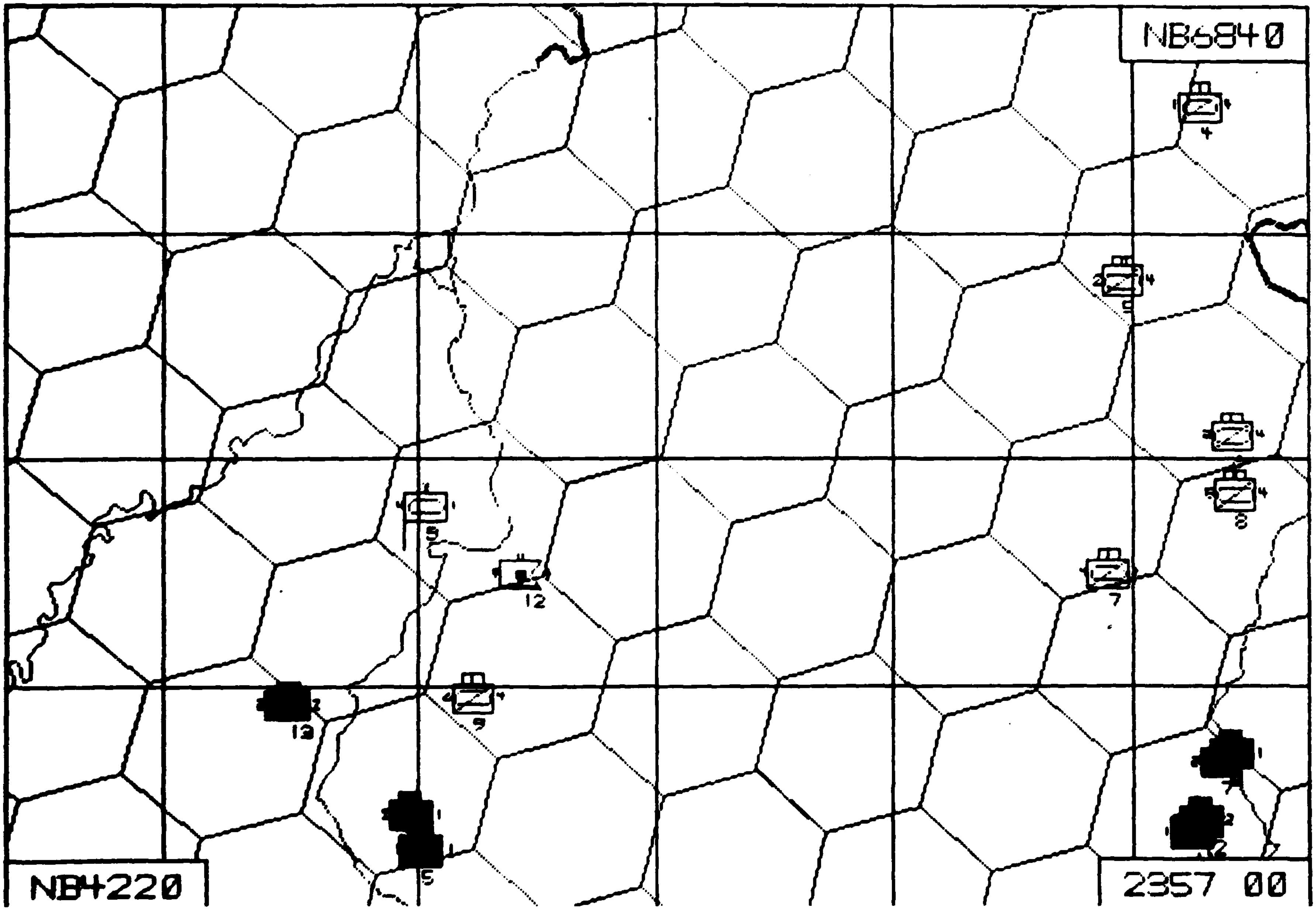


Figure 9

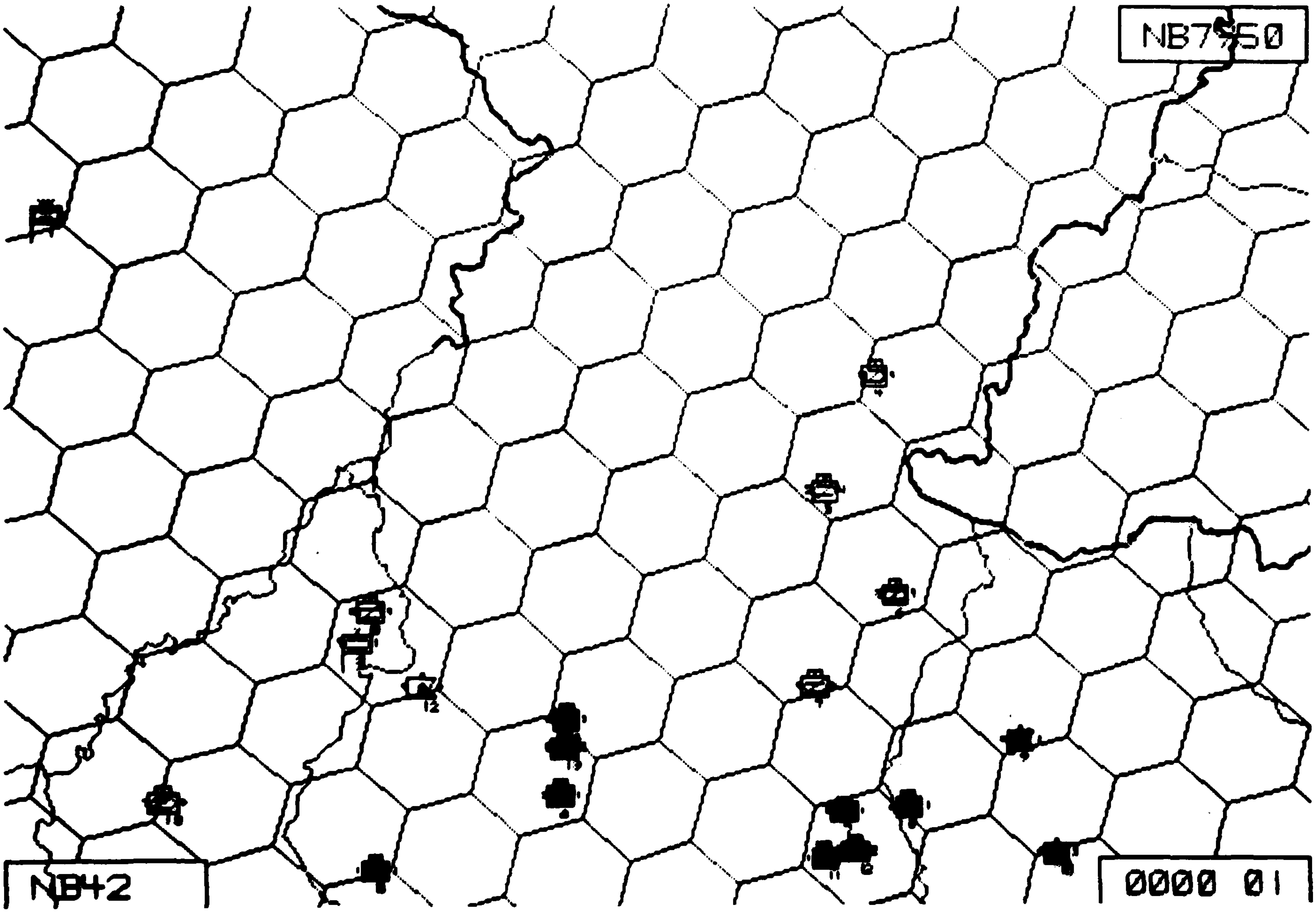


Figure 10

EMS-CORDIVEM SIMULATION RESULTS

	SCENARIO WITHOUT ENGINEERS	SCENARIO WITH ENGINEERS
TIME	RED/BLUE TANK LOSSES	RED/BLUE TANK LOSSES
0800	43/31	43/31
0900	52/39	52/39
1200	55/41	53/40
1400	58/46	53/40
1600	61/49	56/41
1800	68/62	
2000	69/62	79/48
2400	71/62	86/49
END	73/62	88/49

Figure 11

ENGINEER MODEL OPERATIONS

- RECEIVES ORDERS
- DECREMENTS RESOURCES
- DECREMENTS TIME
- MODIFIES TERRAIN
- ISSUES STATISTICS

Figure 12